

CLAIMS

1. A method of manufacturing a heat sink assembly, comprising:
- (a) forming a base from a first graphite material;
 - (b) forming a plurality of separate fins from a second graphite material;
 - (c) assembling the base and the fins into a heat sink assembly; and
 - (d) bonding the base and the plurality of fins together.
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2. The method of claim 1, wherein the first and second graphite materials are the same form of graphite material.
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3. The method of claim 1, wherein the first and second graphite materials are both resin-impregnated graphite materials.
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4. The method of claim 3, wherein:
in step (d), the bonding is achieved by clamping together the base and the fins, and curing the resin-impregnated graphite materials.
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5. The method of claim 1, wherein:
in step (a) the base is formed by compressing a powdered graphite material; and
in step (b), the fins are formed from a sheet of flexible graphite material.
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6. The method of claim 1, wherein:
in steps (a) and (b), both the base and the fins are formed from sheets of flexible graphite material.
7. A heat sink assembly for an electrical component, comprising:
a plurality of graphite components, each graphite component being individually formed from graphite materials, the plurality of graphite components including:
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a base constructed for heat transfer connection to the electrical component;
and

a plurality of fins; and

the base and the fins being assembled together so that a heat transfer path between the electrical component and each of the fins includes at least one interface between abutting surfaces of two of the graphite components, the two graphite components being bonded together at the interface.

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8. The assembly of claim 7, wherein the base and the fins are all formed from the same form of graphite material.

10 9. The assembly of claim 8, wherein the graphite material is a flexible sheet graphite material.

10. The assembly of claim 8, wherein the graphite material is a resin impregnated anisotropic flexible graphite sheet.

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11. The assembly of claim 7, wherein:

the graphite materials are resin impregnated graphite materials; and

the bond at the interface of the two graphite components is a bond of the resin formed by curing the resin after the graphite components are clamped together at the interface.

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12. The heat sink assembly of claim 7, wherein:

the fins are planar and have a relatively high thermal conductivity in the plane of each fin, and have a relatively low thermal conductivity perpendicular to the plane of each fin.

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13. The heat sink assembly of claim 7, wherein:

the base is formed by compression of a graphite powder and includes graphene layers primarily aligned in planes parallel to a first direction, which first direction is perpendicular to a direction of compression of the graphite powder.

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14. The heat sink assembly of claim 7, wherein:

the base includes graphene layers aligned primarily in planes parallel to a direction of heat conduction from the base toward each of the fins.

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15. A heat sink apparatus for an electronic component, comprising:

a base constructed from a first graphite material; and

a plurality of elongated fins, each fin extending at least partially into the base, the plurality of fins each having a length extending away from the base parallel to each other, each fin being constructed of a second graphite material including graphene layers aligned in planes parallel to the length of the fins.

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16. The apparatus of claim 15, wherein:

the fins are formed by rolling down and compacting an anisotropic flexible graphite sheet between shaped rollers to align the graphene layers in planes parallel to the length of the fins.

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17. The apparatus of claim 15, wherein:

the fins each have a thermal conductivity parallel to their length substantially greater than a thermal conductivity of the fins perpendicular to their length.

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18. The apparatus of claim 15, wherein:

each of the fins has a rounded shaped cross-section perpendicular to its length.

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19. The apparatus of claim 15, wherein:

the base includes a plurality of stacked base pieces having complementary recesses formed therein, so that the recesses of two adjacent stacked base pieces are aligned to define openings through the base, each opening being shaped to closely receive one of the fins therein.

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20. The apparatus of claim 19, wherein:

the base pieces and the fins are bonded together by clamping the base pieces and fins together and then curing the base pieces and fins to create a bond therebetween.

21. The apparatus of claim 19, wherein the base comprises:

5 first and second opposite planar sides, the fins extending from the first planar side of the base with the length of the fins oriented perpendicular to the first planar side; and

a thermal interface formed from a sheet of anisotropic flexible graphite material spanning the base pieces and defining the second planar side of the base.

10 22. The apparatus of claim 21, wherein:

the base pieces are constructed from a resin impregnated graphite sheet material;
and

15 the thermal interface is constructed from an unimpregnated graphite sheet
material.

23. The apparatus of claim 19, wherein:

the base pieces are formed by rolling down and compacting an anisotropic
flexible graphite sheet between shaped rollers to align the graphene layers in planes
parallel to the lengths of the fins.

20 24. The apparatus of claim 19, wherein the plurality of stacked base pieces comprises:

two end base pieces, each having the recesses on only one side thereof; and

at least one intermediate base piece having the recesses on two opposite sides
thereof.

25 25. The apparatus of claim 15, wherein:

the base includes graphene layers of the first graphite material aligned primarily
in planes perpendicular to the lengths of the fins.

30 26. The apparatus of claim 25, wherein:

the base is formed by die pressing a graphite powder to form the base about end portions of the fins.

27. The apparatus of claim 15, wherein:

5 the base includes a thermal interface formed from a sheet of anisotropic flexible graphite material bonded to the base on a side of the base opposite the fins.

28. The apparatus of claim 15, wherein:

10 the first and second graphite materials from which the base and fins are constructed are both epoxy resin impregnated graphite materials.

29. A method of manufacturing a heat sink apparatus for an electronic component, comprising:

15 (a) rolling an anisotropic flexible graphite sheet between shaped rollers to produce a plurality of parallel elongated continuous fin stock members defined in the rolled sheet;

20 (b) cutting off a portion of the rolled sheet having a length corresponding to a fin length;

25 (c) separating the fin stock members of the cut-off portion of the rolled sheet to create a plurality of separate elongated fins; and

30 (d) forming a generally planar base bonded to the fins so that the fins extend from the base in a direction generally perpendicular to the plane of the base.

30. The method of claim 29, wherein step (d) comprises:

25 rolling another anisotropic flexible graphite sheet between other shaped rollers, and cutting the other sheet into a plurality of base pieces having recesses; and

30 stacking the base pieces so that the recesses of adjacent base pieces combine to form base openings in which the fins are received.

31. The method of claim 30, further comprising:

clamping the stacked base pieces and fins;

curing the clamped base pieces and fins; and
thereby bonding the base pieces and fins together.

32. The method of claim 29, further comprising:

5 die pressing a powdered graphite material to form the base about end portions of the fins, so that graphene layers of the base are aligned in planes perpendicular to lengths of the fins.

33. The method of claim 29, wherein:

10 step (a) includes aligning graphene layers of the anisotropic flexible graphite sheet in planes parallel to the length of the fins as the anisotropic flexible graphite sheet is rolled between the shaped rollers.

15 34. The method of claim 29, wherein step (a) comprises:

rolling the anisotropic flexible graphite sheet with a series of shaped rollers, so that the material between fin stock members is increasingly reduced as the sheet passes each shaped roller.